# SECTION 05 12 00
# STRUCTURAL STEEL

## PART 1 - GENERAL

### 1.1 SCOPE

A. Includes furnishing all materials, equipment and transportation and performing all labor necessary for construction of structural steel as described herein and as shown and/or noted on the Drawings.

B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to Work of this section.

C. Alternate bids: Refer to other Sections for description.

### 1.2 CODES AND STANDARDS

A. The Work described in this Section, unless otherwise noted on the Drawings or herein specified, shall be governed by latest editions of the following Codes or Specifications:

1. "Code of Standard Practice for Steel Buildings and Bridges", AISC, including commentary, latest edition.

2. AISC's "Specification for Structural Steel Buildings–Allowable Stress Design and Plastic Design."

3. AISC's "Load and Resistance Factor Design (LFRD) Specification for Structural Steel Buildings."

4. AISC's "Specification for Allowable Stress Design of Single-Angle Members."

5. AISC's "Specification for Load and Resistance Factor Design of Single-Angle Members."

6. AISC's "Seismic Provisions for Structural Steel Buildings."

7. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

8. "General Requirements for Rolled Steel Plates, Shapes, Sheet Piling and

Bars for Structural Use" - ASTM A6.

9. Applicable Material Specification - ASTM.

10. "Structural Welding Code" - AWS D1.1.

11. "Specification for Structural Joints Using ASTM A325 or A490 Bolts" - As approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation, latest approved edition.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for the Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.

1. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified Plant as follows:
   a. Category: Category I, conventional steel structures.
   b. Category: Category II, complex steel building structures.
   c. Fabricator shall be registered with and approved by authorities having jurisdiction.

C. Welder Certification Testing: Employ a testing laboratory experienced in welder certification testing to perform welder certification tests in accordance with AWS D1.1

1.4 SUBMITTALS

A. Product Data: Submit producer's or manufacturer's specifications and installation instructions for the following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).

1. Structural steel (each type), including certified copies of all mill reports covering chemical and physical properties.

2. High-strength bolts (each type), including nuts and washers.

3. Structural steel primer paint.

4. Non-shrink grout.

B. Shop drawings: Submit shop drawings prepared under the supervision of a registered Professional Engineer licensed in the State in which the project is located in accordance with Specifications.

1. Show complete details and schedules for the fabrication and shop assembly of members. Detail to conform to AISC "Structural Steel Detailing". Clearly indicate profiles, sizes, spacing and locations of structural members, connections, attachments, anchorages, framed openings, size and type of fasteners and cambers. Show AWS weld types.

2. Shop drawings shall include erection sequences, procedures and diagrams, schedules, and complete details. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed by others. Any fabrication of material before review of shop drawings shall be at the risk of the Contractor.

3. The Contractor shall completely outline a proposed method and sequence of erection to the Architect for review before delivering any material to the job site. The outline shall be prepared to avoid delay or any damage to the work of other trades.

4. Proposed Substitutions: Substitutions of sections or modifications of details, if proposed by the Contractor, shall be submitted for review in sketch form prior to submission of shop drawings.

C. Welder's Certificates: Submit Welder's Certifications performed by a qualified testing laboratory in accordance with AWS D1.1, “Structural Welding Code - Steel.”

D. Test Reports: The Testing Laboratory shall submit copies of reports of shop and field inspections and tests performed in accordance with Specifications.

1.5 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.

B. Storage of fabricated steel at the job site shall be the responsibility of the Contractor. Material stored at the job site shall be placed so that design loads on existing or newly-constructed structures are not exceeded and members will not be distorted or otherwise damaged. All materials shall be protected against corrosion or deterioration of any kind.

C. The Architect may reject any material that has become damaged because of improper storage.

1.6 FITTING OF STRUCTURAL MEMBERS

A. The Contractor alone shall be responsible for the correct fitting of all structural members and for the elevation and alignment of the finished structure.

1.7 ADJUSTMENTS

A. Any adjustments necessary in the steel frame because of fabrication, construction or erection discrepancies in elevations and alignment shall be the responsibility of the Contractor.

1.8 SEQUENCING/SCHEDULING

A. Coordinate Work of this Section with work of other Sections as required to properly execute the Work and as necessary to maintain satisfactory progress of the work of other Sections.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials shall be of new manufacture and shall conform to the respective specifications and other requirements specified below.

1. Steel: ASTM A36 and A572 or A992, Grade 50, new manufacture, free from defects which would impair strength, durability, appearance or function.

2. Steel Pipe: ASTM A500, Grade B, 42 KSI.

3. Steel Tube: ASTM A501, Grade B, 46 KSI.

4. Bolts: Anchor bolts and erection bolts not specified as high strength shall meet requirements of ASTM A307, Grade A. High strength bolts shall meet ASTM A325, Type 1 or ASTM A490, Type 1 as noted on the drawings.

a. Nuts: ASTM A563 and ANSI B18.2.2.
b. Washers: ASTM A36.
c. Direct tension indicator bolts or load indicator washers conforming to AISC Specifications for Structural Joints and ASTM F 959, Type 490, uncoated.
(1) Load Indicator Bolts - Bethlehem Steel.
(2) Tension Control - Le Jeune.

(3) Coronet Load Indicator - Cooper & Turner, Inc.
(4) Load Indicator Washers - Bethlehem Steel.

5. Welding Electrodes: AWS A5.1 or A5.5 for Series #E70 electrodes.

6. Headed Stud Anchors: ASTM A108, minimum tensile strength 60,000 PSI.

7. Galvanizing: All items of structural steel exposed to weather shall be galvanized in accordance with ASTM A123 (latest edition). All anchors, bolts, washers, etc. in conjunction with galvanized surfaces shall also be galvanized to conform to these requirements.

8. Grout: Refer to Section 03 30 00 for nonshrink grout.

9. Primer/Paint: Shop applied primer and field touch-up Manufacturer's Standard Primer Gray unless noted otherwise. Application standards shall meet or exceed requirements of Federal Specification TT-P-86G, Types I and III. All structural steel which is architecturally exposed and is not galvanized, but is exposed to the weather, shall receive shop applied primer and field touch-up TNEMEC 66-1211, 3 mils thick. No substitutions will be allowed. Finish paint shall be TNEMEC Series 73, 3 mils thick. Color to be selected and approved by Architect.

10. Miscellaneous Materials and Accessories: As specified hereinafter under the various items of work and/or as indicated on the Drawings or as required for good construction practice.

## 2.2 FABRICATION

A. General

1. All work shall be shop assembled insofar as possible and delivered to the site complete and ready for erection. Material shall be properly marked and match-marked where field assembly is required. The sequence of shipments shall be such as to expedite erection and minimize field handling of material.

2. Steel members shall be cambered if so indicated on the Drawings.

3. Steel members without specified camber shall be fabricated so that after erection, any minor camber due to rolling or fabrication shall be upward.

4. Fabricate architecturally exposed structural steel with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.

a. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating, and shop priming.
b. Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.

B. Connections

1. Connections not detailed on the Drawings shall be selected from Part 4 of the Manual of Steel Construction of the AISC.

2. Shop and field connections shall be bolted or welded as detailed.

3. No combination of bolts and welds shall be used for stress transmission in the same faying face of any connection.

C. Shop Welding

1. All welding shall be done in accordance with AWS D1.1.

2. Intermittent and continuous welding shall be done in a manner to minimize internal stresses.

3. Welds not specified shall be continuous fillet welds, sufficient to transmit required forces, using minimum fillet as specified by AWS D1.1.

D. Openings for Other Work: Provide openings in structural members only as shown on the structural drawings, or as directed by the Architect.

E. Shop Painting

1. Shop paint structural steel work, except those members or portions of members to be embedded in concrete or mortar, or contact surfaces which are to be welded or high-strength bolted. Paint embedded steel on exposed portions and initial 2" of embedded areas only.

2. Surface Preparation:
   a. Steel to receive Manufacturer's Gray Primer: Clean steelwork to be painted, complying with SSPC (Steel Structures Painting Council) SP-3 "Power Tool Cleaning". Remove oil, grease and similar contaminants, complying with SSPC SP-1 "Solvent Cleaning".
   b. Steel to receive TNEMEC Series 66 Primer: Clean steelwork to be painted, complying with SSPC (Steel Structures Painting Council) SP-6 "Commercial Blast Cleaning". Remove oil, grease and similar contaminants, complying with SSPC SP-1 "Solvent Cleaning".

3. Application: Immediately after surface preparation, apply one coat of structural steel primer paint according to manufacturer's instructions to provide a uniform dry film thickness of 2.5 mils. Provide full covering on joints, corners, edges and all exposed surfaces.

F. Galvanizing

1. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated for galvanizing according to ASTM A 123.

G. Source Quality Control

1. Access to places where material for the contract is being fabricated or produced shall be provided to the Architect and/or the Testing Laboratory for the purpose of inspection.

2. The Testing Laboratory may inspect structural steel at the plant before shipment. However, the Architect may reject any material, at any time, before final acceptance, which does not conform to all of the requirements of the Contract Documents.

3. Shop inspection and testing shall be performed by the Testing Laboratory in accordance with Section 014326 and the Quality Control portion of Part 3 of this Section.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Templates shall be secured in place to preclude misplacement of anchor bolts, and the bolts shall be installed at locations and with projections established on final structural steel shop drawings.

B. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

### 3.2 ERECTION

A. Tolerances: Set structural members to the lines and elevations indicated. Unless otherwise noted, individual members of the structure shall be leveled and plumbed to an
accuracy of 1 to 500, but not to exceed two inches (2") in columns for their full

height.

B. Temporary Connections: Shall be designed to adequately resist all gravity and lateral loads, and erection stresses. The method of temporary connections shall be shown on the shop drawings.

C. Field Bolting: Drift pins shall not be used to enlarge unfair holes in main materials. Burning and drifting may be used to align unfair holes in secondary bracing members only after evaluation by the Architect.

D. Grouting of Base Plates and Bearing Plates: Plates shall be set and anchored to the proper line and elevation. Metal wedges, shims, and/or setting nuts shall be used for leveling and plumbing of structural members, including columns. Concrete surfaces shall be rough, free of oil, grease, and laitance, and shall be damp. Surfaces shall be clean and free of oil, grease, and rust. The addition of water, mixing and placing shall be in conformance with the material manufacturer's instructions. Grouting shall be mixed by using mortar mixer. Batches shall be of size to allow continuous placement of freshly mixed grout. Placing shall be quick and continuous. Exposed surfaces shall have smooth dense finish.

E. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

1. Maintain erection tolerances of architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

F. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when complete and in service.

G. Splice members only where indicated.

H. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.

I. Headed Stud Anchor Welding: All members or items to which studs are to be

attached must be free of all foreign material, such as rust, oil, grease, paint, etc. When the mill scale is sufficiently thick to cause difficulty in obtaining proper welds it must be removed by grinding or sandblasting. Ceramic ferrules used in the stud welding process shall be completely removed.

3.3 CLEAN-UP

A. Refer to Division 1 Section 017419.

3.4 FIELD CLEANING AND TOUCH-UP PAINTING

A. Prepare and coat welds, fasteners, burned and abraded areas as noted under Shop Painting.
B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A 780.

3.5 FIELD QUALITY CONTROL

A. Contractor shall provide the Testing Laboratory with names of welders to be employed on work, during fabrication and erection, together with certification that each of these welders has passed qualification tests within the last year, unless noted otherwise, in accordance with AWS Standards.

B. Inspect all structural steel during fabrication and during and after erection for conformance with Contract Documents and Shop Drawings. Any cases of insufficient bracing or guying, or other unsafe conditions shall be immediately called to attention of Contractor and reported to Architect.

1. No burning or other field corrections of steel members are permitted without express permission of Owner's representative. Immediately report violations.

2. Shop Inspection:
   a. Review shop drawings and shop procedures with fabricator's supervisory personnel.
   b. Request and obtain necessary mill certifications of steel and verify proper material throughout the duration of the job, as required.
   c. Review welding procedures and welder operator qualifications for conformance to the technical requirements of the Specifications.
   d. Check layout and dimensions of jigs and fixtures for multiple fabrication, joint preparation, fit-up, and runout plates.
   e. Verify welding electrodes to be used and other welding consumables as job progresses.
   f. Check preheating procedure for uniformity and thoroughness through the full thickness of material.
   g. Make visual inspection of welding in progress for size, length and

quality.

h. Check bolted connections as required by the technical requirements of the Specifications.
i. Perform random dimensional checks of completed members.
j. Provide inspection of surface preparation for coating and coating operations.
k. Check shipping preparation schedules and obtain copies of shipping lists.

3. Field Inspection
   a. Obtain planned erection procedure, and review with erector's supervisory personnel.
   b. Check installation of anchor bolts and base plates.
   c. Verify field welding procedures and welder qualifications to assure conformance with the Specifications.
   d. Check Steel as received in field for possible shipping damage, workmanship and piece marking.
   e. Check plumbness, alignment and camber as erection progresses including proper bracing.
   f. Check joint preparation, fit-up, backing strips and runout plates.
   g. Check preheating to assure proper temperature, uniformity, and thoroughness through the full material thickness.
   h. Review welding sequence.
   i. Visually inspect field welding for size, length, and quality.

4. Inspection of High-Strength Bolted Construction shall be in accordance with the latest edition of AISC Specification for Structural Joints, and as follows:
   a. All high-strength bolted connections shall be visually inspected.
   b. At least two bolts of every third connection between beams and girders shall be checked with a calibrated torque wrench for proper torque.
   c. At least two bolts of every third connection between girders and columns shall be checked as above.
   d. All bolts in every connection in the primary exterior framing and braced framing shall be checked as above.
   e. All bolted connections that fail shall be corrected and all bolts in that connection shall be retested.
   f. Check calibration of impact wrenches at least twice daily.

5. Inspection of all welds shall be in accordance with the latest edition of the AWS Structural Welding Code.
   a. Visually inspect all welds in accordance with AWS D1.1.
   b. Penetration welds in full moment connections and column splices shall be inspected by ultrasonic testing in accordance with ASTM E-164 and the following table:

| Level | Percentage of Welds to be Tested |
|---|---|
| All Levels | 100% |

c. All penetration welds in the primary exterior framing shall be inspected by ultrasonic testing in accordance with ASTM E-164.
d. All penetration column-to-base plate field welds shall be inspected by ultrasonic testing as above.
e. Column splice welds shall be inspected by ultrasonic testing as above.

6. Inspection of headed stud connector welding shall be in accordance with the latest edition of the AWS Structural Welding Code and as follows:
   a. Visual inspection of all studs shall indicate complete fusion and weld flush or fillet for 100 percent circumference. There will be no indication of lack of fusion or undercut weld.
   b. If visual inspection reveals that a sound weld or a full 360 degree fillet has not been obtained for a particular stud, such stud shall be struck with a hammer and bent 15 degrees off perpendicular to the nearest end of the beam or plate. In addition, a minimum of five (5) percent of all studs shall be tested by hammer as specified above. Test a minimum of one (1) per plate, two (2) per beam and four (4) per girder. Studs failing under this test shall be replaced.

C. Testing Laboratory services shall be in accordance with Section 01 43 26. Provide all inspections and testing as required by the 2006 International Building Code.

END OF SECTION

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